

THE CHALLENGE AND COUNTERMEASURES BROUGHT BY THE SHORTAGE OF OIL AND GAS IN CHINA

Pang Xiongqi, Meng Qingyang, Zhang Jun, and Feng Lianying

Basin and Reservoir Research Center,

China University of Petroleum,

Beijing, China

pangxq@bjpeu.edu.cn

richard5948@163.com

Abstract: The recent development of China's economy is very striking, it also has caused a great increase in the demand on oil and gas. It is hard to meet this demand for resources. It is a great challenge to handle with the conflict between oil and gas shortage and fast growth of economy. Many scholars have put forward various solutions for this matter. Some recommend the way of overseas exploration, i.e., meeting the shortage through exploiting the overseas resources, but there are great risks in doing so. And some propose mass importation of oil and gas resources, but if this happens, we will be vulnerable to the worldwide petroleum shortage and high oil prices. Dependence on imports may also imperil the national strategic security since high dependency of oil importation is dangerous to a nation. In the long term, fastening the exploration and development in domestic oil and gas resources, advocating oil saving and looking for substitute energy are the best ways.

Key words: Oil shortage in China, Challenge and countermeasure, Prediction on oil consumption, Prediction on oil importation

1. Great demand of oil and gas resources for the economic development

Since the year of 1978, estate, automobile and capital construction trade have led to fast growth of economy in China. And steel, nonferrous metals, building materials, and chemical industry are supporting factors for the growth of economy. China has entered a high-sustainable developing stage of heavy-chemical industry. The expanding basis for these industries lie in abundant oil and gas resources and they will suffer great impact without stable supply of oil and gas. In this way, to guarantee the economic development of our nation needs an assured oil supply.

1.1 The China's economy has experienced rapid and stable development for many years

Since the 1990s, China has sustained at a high level of economic development. The average rate of increase of gross domestic product (GDP) of our country reached nearly 12% during the State's Eighth Five-Year Plan period (from 1991 to 1995), China has maintained a GDP increase rate of more than 8% over the past 10 years. (Chart 1) Such a strong GDP growth is the highest in recent years, not only at home, but even in the whole world. High economic growth has made social productivity, overall national strength and living standards in our country have all reach a new level. Based on this, the economy of China will surely keep a rapid and steady development for a rather long period of time.

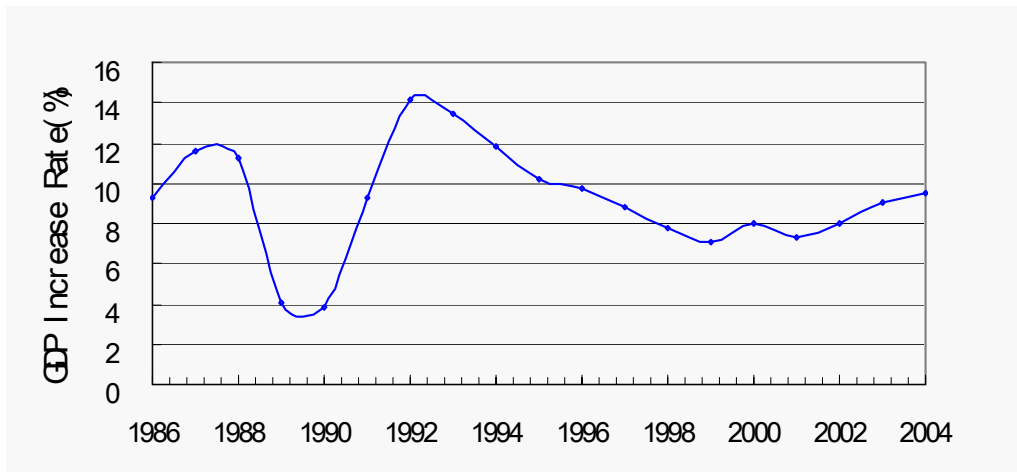


Chart 1. GDP increase of China in the last decade

1.2 The development of China's economy needs a lot of oil and gas

Oil and gas form the lifeblood of the development of the world's economy. With the rapid and steady increase of China's economy, the consumption of oil and gas is also increasing rapidly. (Chart 2) Because of the many advantages of gas (high-efficiency, environmental protection, abundance, low cost, ease of transport and convenience), the proportion of natural gas in our country's energy-consumption is increasing constantly, which can alleviate the pressures caused by the shortage of oil and other energy at the same time. (Chart 3)

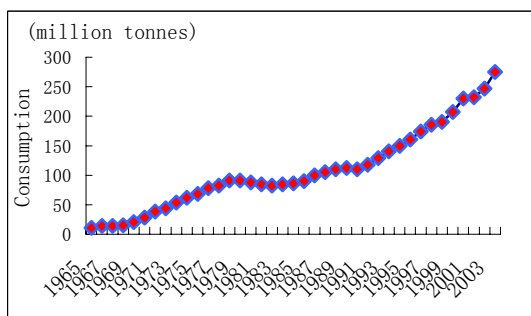


Chart 2. China's oil consumption figure

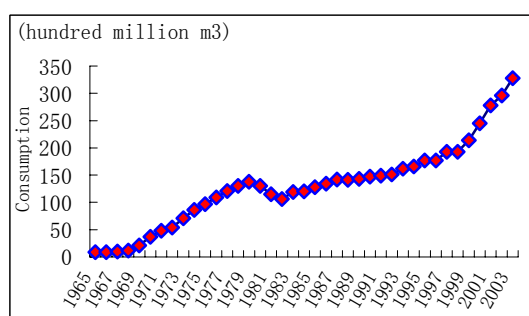


Chart 3. China's gas consumption figure

1.3 The annual oil consumption of China will increase continually with the development of its economy.

After 25 years' reform and opening-up to the world, the oil consumption of our country has gone through two stages on the whole. Between 1978 and 1990, the oil consumption was at a steadily increasing stage. (Chart 4) Consumption rose from 90,920,000 tons in 1978 to 114,860,000 tons in 1990, increasing 1,990,000 tons averagely every year at the rate of 2%. Since 1991, with the continually rapid growth of the economy in China, oil consumption has entered a stage of very rapid increase. The oil consumption was 267 million tons in 2003, increasing 11,730,000 tons averagely at the rate of 6.7% every year. The growth rate accelerated further in the past two years. Compared with 2001, the volume of consumption of oil had a net increase of 39 million tons in 2003, with an annual increase rate of 8.2%. Until at least 2020, China is likely to continue in a new round of economic increase. It is estimated that the GDP of China will grow at the rate of 7% or even higher for that period, so the oil consumption of China will continue to increase rapidly on current proportions. (Chart 5 and Chart 6)

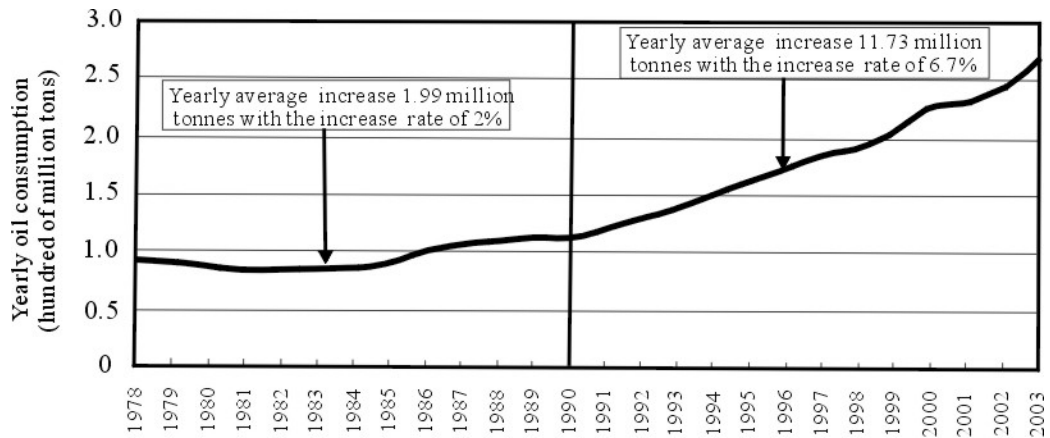


Chart 4. China's oil consumption increase figure in recent years

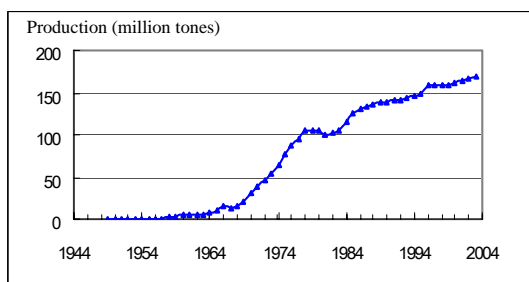


Chart 5. China's oil demand in past 40 years

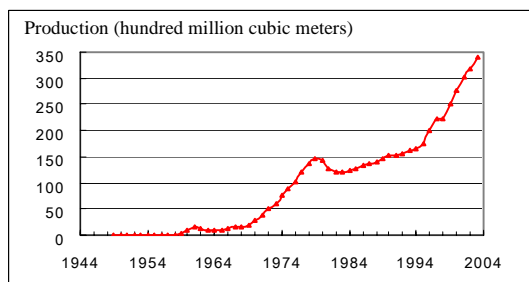


Chart 6. China's gas demand in past 40 years

2. The oil and gas production in China can't meet the demands of economic development

The continuing rapid growth of China's economy will need the guarantee of a large amount of oil and gas resources. But meanwhile, though the exploration level in China belongs to a relatively mature stage compared with the whole world, the main oilfields of China have generally entered a declining production stage. It is harder and harder to keep the production steady. At the same time, the exploration difficulty is also increasing with higher exploration costs. This results in the great shortage of domestic oil and gas resources, which is failing to meet the demands of the economy.

2.1 Oil and gas production in China is increasing slowly

In recent years, most of the old oil fields in eastern China have entered a mature production and high water-cut stage. The production decreases progressively year by year. Although the exploration had some successful experiences in the western and marine areas of China, the production of these areas has little left after filling the decline of production in the eastern area, which has caused the slow increase of oil and gas production in China. (Chart 7) The natural gas production in China shows an increasing tendency in recent years compared with that of oil. (Chart 8) The discovery and exploitation of several gas fields in the west of China enable the gas discovered there to be sent by pipeline to the eastern area where natural gas is in short supply. This can not only alleviate the pressure of energy shortage in the eastern area but also make very great contribution for economic development at the same time. The slow increase of oil production and the steady increase of natural gas production has led to the distinct contrast in the oil and gas production predictions in the following 15 years made by different scholars. (Tables 1,2 and Chart 9,10)

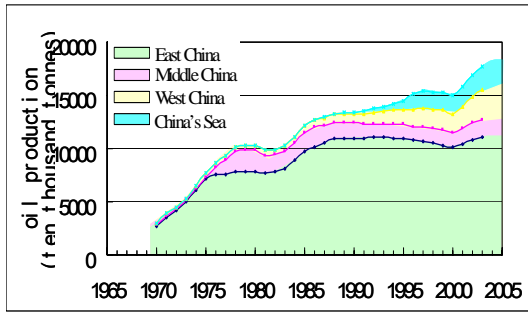


Chart 7. China's oil production from 1970-2004

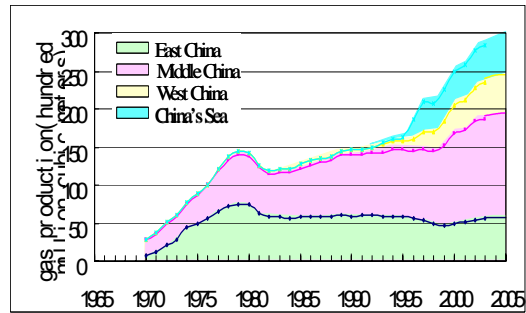


Chart 8 China's gas production from 1970-2004

Table 1 Prediction on China's future oil production by different scholars

Prediction on oil production (hundred million tonnes)							
Year	Guo Baoshen (1997)	Jia Wenrui (2003)	Mu Shuling (2004)	Chen Yueming (2002)	Zhou Zongying (2001)	Shen Pingping (2004)	Average
2010	1.47	1.75	1.8~1.9	1.7~1.8	1.76	1.7~1.8	1.70
2020	0.82	1.6	1.8~2	1.9~2.0	1.68	1.9~2	1.57

Table 2 Prediction on China's future gas production by different scholars

Prediction on gas production (hundred million m ³)						
Year	Zhou Zongying (2003)	Jia Wenrui (2003)	Mu Shuling (2004)	Wan Jiye (1997)	Zhao Fuxing (1996)	Average
2010	700~740	800	800~900	800	500~600	744
2020	1100	1200	1400~1500	1000	700~1000	967

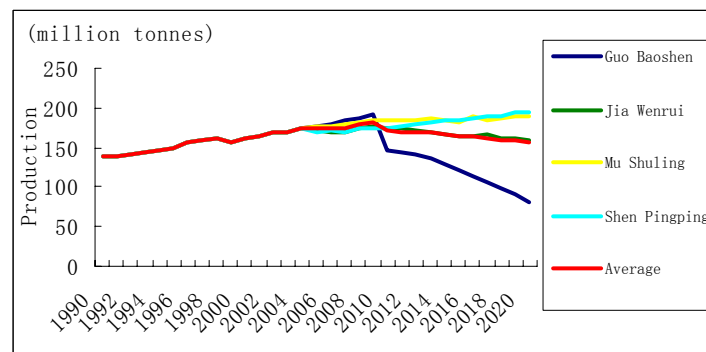


Chart 9 Prediction on China's oil production by different scholars

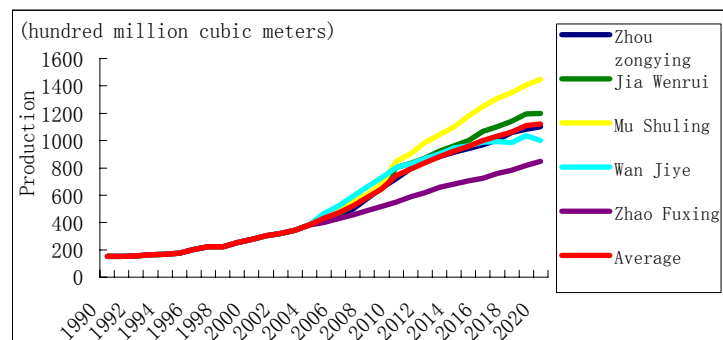


Chart 10 Prediction on China's gas production by different scholars

2.2 The oil and gas import is increasing greatly year by year

It is very hard for the domestic oil and gas production to meet the enormous demand brought by the economic development, so importing considerable oil and gas resources becomes inevitable. The annual volume of oil and gas importing is increasing at a surprising speed and the proportion of import in gross consumption is increasing rapidly. (Table 3,4) This is a very important trend which should not be overlooked.

According to some foreign research institutions, when the oil importation of a nation has reached 100 million tonnes or its importation dependency reaches 50% or more, some comprehensive measures such as economical, trade, and diplomatic ones would be necessarily taken to construct this nation's strategic guarantee system of oil security, including the domestic and international oil supplies system, international oil trading system and national oil reserve system, in order to obtain stable oil and gas resources and guarantee the national petroleum security.

Table 3 Prediction on China's oil import by different scholars or departments

prediction on oil importation (hundreds of million tonnes)					
Year	Tsinghua University (1990)	Zhang Rong (2004)	Mineral Resources Dept.(1991)	Mu Shuling (2004)	Average
2010	2.25	1.7	1.85~2	1.5	1.85
2020	2.5	2.7	2.3~2.5	2.0	2.4

Table 4 Prediction on China's gas import by different scholars

prediction on gas importation (hundreds of million m ³)			
Year	Zhang Kang (2001)	Mu Shuling (2004)	Average
2010	230	150	190
2020	500	1000	750

2.3 The annual importation of oil and gas will increase with economic development in the future

Until at least 2020, our country will still be in a new round of economic development. It is estimated that GDP will increase continuously at a speed of more than 7%. Industrialization and urbanization process will be accelerated obviously, but the economic structure focuses on heavy-chemical industry that will not experience fundamental change easily. The automobile industry and petrochemical industry as the pillar industries of our country will speed their development. The consumption rate of oil by urban citizens will rise by a large margin, and the proportion of oil consumption will also increase in the consumption structure of rural energy. Under the influence of many factors, it is estimated that the oil consumption will keep increasing rapidly in China. (Chart 11,12)

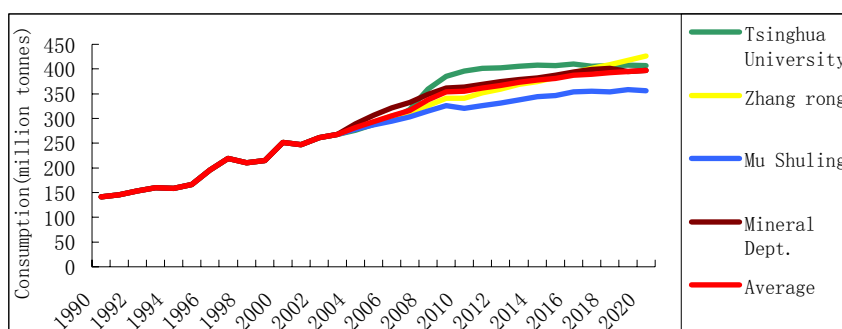


Chart 11. Prediction on oil demand in China by different scholars and departments

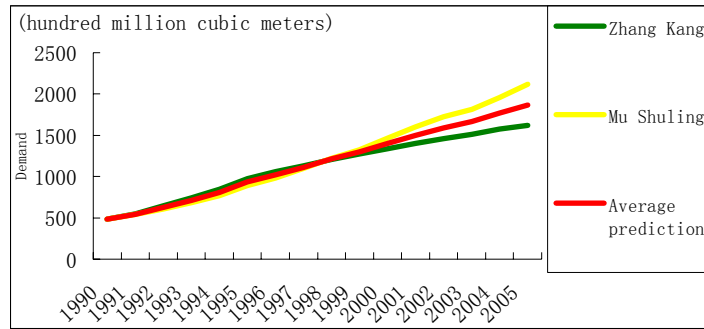


Chart 12. Prediction on gas demand and production in China by different scholars

3. Challenge brought by the shortage of oil and gas and possible countermeasures

The great demand for oil and gas caused by the rapid development of the economy and the slow increase of domestic oil and gas production has resulted in the shortage of oil and gas in our country. (Chart 13,14,15) This is a difficult problem and substantial challenges faced by us. Facing the problem of oil and gas shortage, some foreign scholars have brought about a series of suggestions and countermeasures. (Chart 16) To China, there are four main measures that can be taken to solve this problem. The first measure is to innovate geological theory and fasten the exploration and development of domestic oil and gas resources. The second measure is to improve the proportion of overseas oil and gas resources. The third measure is to develop substitute energy. The fourth measure is to adopt measures to save oil.

Production and demand (million tones)

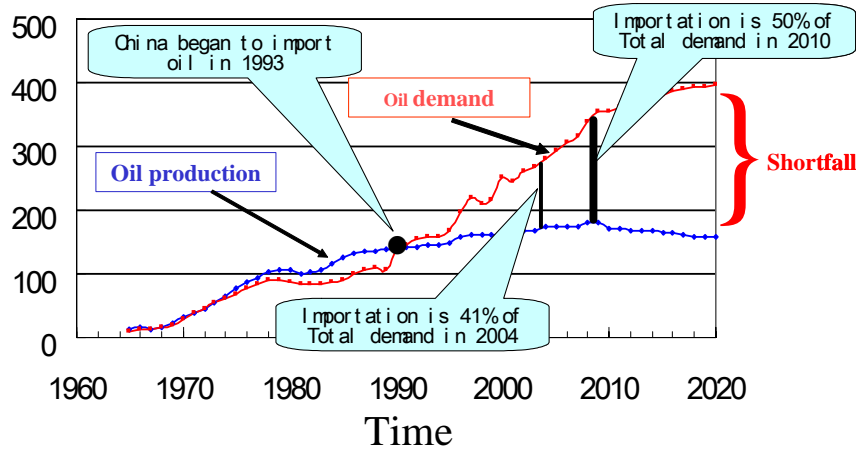


Chart 13. Prediction on oil consumption and demand in China

Production and demand (hundred million cubic meters)

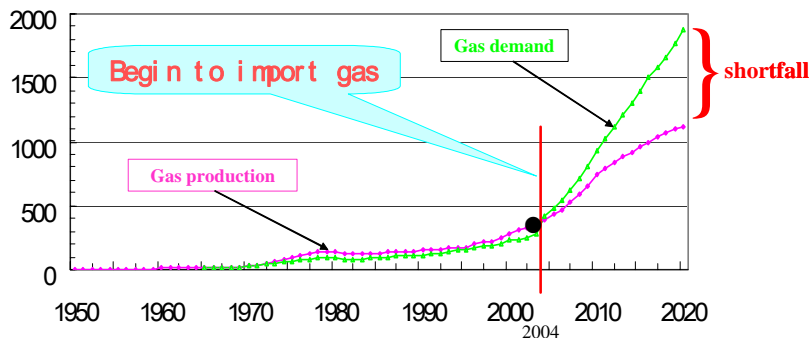


Chart 14. Prediction on gas consumption and demand in China

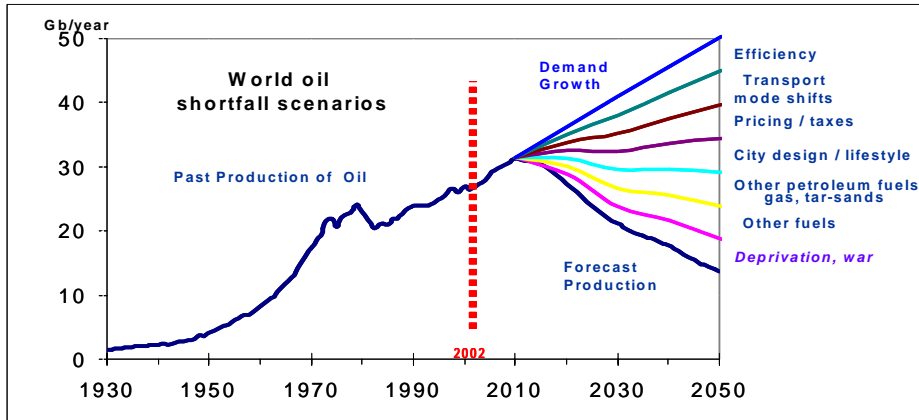


Chart 15. The shortage situation and countermeasures to solve the problem in the world (Bruce Robinson,2004)

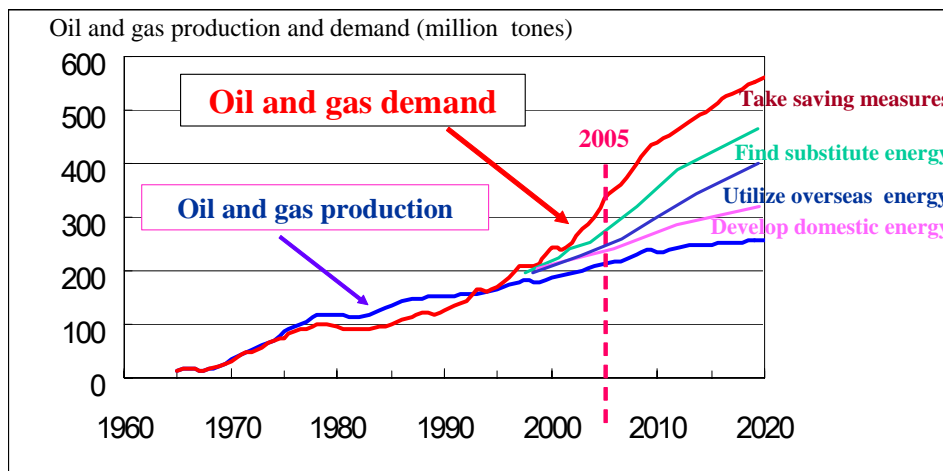


Chart 16. The shortage situation and countermeasures to solve the problem in China

3.1 Innovate geological theory and fasten the exploration and development of domestic oil and gas resources

The stability and development of the production of domestic oil and gas are foundations of ongoing development of petroleum resources of our country. The rate of proved oil and gas resources are separately 38.9% and 23%. Comparing with the average proved rate of the world of 73% and 60.5%, there are still large potentials. During the process of accelerating development and utilization, we should further strengthen the exploration of new areas, and discover the latent potential of old areas, accelerate promoting the exploitation on the difficult developing reserves, which then can help maintain reserves and production.

3.2 Participate international competition and increase the proportion of importing oil and gas

When it is difficult for the production of domestic oil and gas to meet the enormous demand for economic development, implementing the international strategy, developing overseas oil and gas resources actively to expand the proportion of foreign resources is a good choice. But we may face great risks while acquiring interests and benefits. We will encounter severe competition with large international oil companies of developed countries to get a share from such comparatively easy area to obtain production as the Middle East, southeast Asia and Russia. But in such regions as West Africa, South America, etc., though the keen competition with other companies can be reduced, problems of exploration difficulty,

high-cost, political instability and some other unfavorable factors and risks are inescapable.

3.3 Increase the expenses on science and technology and develop substitute energy

Under the condition of the slow increase of domestic resource and the intense competition and challenge of exploiting overseas energy, especially the great damage to economy development caused by the continuous high oil price, it may be an urgent affair and an inevitable choice to develop alternative energy resource.

Biodiesel: The biological diesel oil (biodiesel) can be an effective additive to or substitute for the diesel engine fuel. In the past 20 years, countries of all over the world have started to make biodiesel from vegetable oil as an alternative to petroleum. Compared with petrochemical diesel oil, the biodiesel has the following advantages:

It has fine environmental protection characteristics. The content of sulfur in biodiesel oil is low, which can help reduce the emission of SO₂ by about 30%. Biodiesel does not include aromatic hydrocarbons that may cause pollution to the environment, and the harm of its waste gas to the human body is lower than that of the petrochemical diesel oil.

The biological degradability of the biodiesel is high, and will not do as much harm to people's health.

It is a fine lubricant, thus lengthening the service life of the engine.

It is safe. Because of its high flash point the biological diesel oil is not the dangerous material. The biodiesel is not as dangerous as petrol. The biodiesel is difficult to volatilize, its biodegradation rate is up to 98%, about 2 times that of the petrochemical diesel oil.

Gas hydrates: Gas hydrates called by scientists "solid gas" is a naturally occurring form of methane locked in ice. It is a crystalline solid consisting of gas molecules, usually methane, each surrounded by a cage of water molecules. It looks very much like water ice. Methane hydrate is stable in ocean floor sediments at water depths greater than 300 meters, and where it occurs, it is known to cement loose sediments in a surface layer several hundred meters thick. Gas hydrate is considered to be a possible energy source because of its high energy density, wide distribution and large scale. After the former Soviet Union's finding the solid gas in the Siberian oil and gas field in 1965, U.S.A. found in succession in the area of the Atlantic Ocean of its east coast and sea trough of Central America of the Eastern Pacific in 1979. Afterwards, countries such as Great Britain, France, Germany, Japan, Norway, Canada, Russia, etc. successively made investigations too. However, there are very serious doubts that any economic production of natural gas from methane hydrates will possible within the foreseeable future. This is in part due to the large amount of energy which may be needed to mine hydrate on the sea floor, or to convert it to gas which can be captured and used. Our country has not taken to the investigation for the amount and distribution of solid gas at present.

3.4 Oil conservation, an important way to ensure sustainable and steady development

A basic way to alleviate the imbalance between supply of oil and gas resources and demand in our country is to save oil. It is likely to be much cheaper and more practical to reduce fuel usage than to import the equivalent amount of oil. China is a country of large oil and gas consumption, at the same time it is one of low oil utilization efficiency and serious unreasonable use. Compared with the current international petroleum consumption intensity (petroleum consumption / GDP thousand dollars), the intensity of petroleum consumption of our country is 0.19, equivalent to 4 times that of Japan, 3 times that of Europe, twice that of U.S.A. Under the circumstances that the production of domestic petroleum can not be

increased by a large margin in the future, and the necessity to control the dependency to overseas resources, we must give high priority to saving oil and stress it as a fundamental state policy of our country. In order to ensure the long-term sustainable development of national economy with less petroleum consumption, we should mobilize the whole society to save oil in a more cost-effective manner and improve petroleum utilization efficiency. China's petroleum industry has benefited greatly by adopting and then improving techniques proven overseas. There is likewise very considerable scope in oil conservation to learn similarly from both the good and the bad examples from around the world. We should implement and improve the most successful and productive fuel conservation strategies, while avoiding the serious oil-wasting mistakes made by other nations. China's transport system has in the past been very successful without depending much on private automobiles. If China relinquishes its heritage use of public transport and bicycle transport and instead takes the road to western automobile-dependent cities, there will be enormous consequences for its oil consumption. As well, the health, social and environmental problems that automobile dependence has brought to many western countries will also become serious in China. Measures to control the growth of fuel usage include: fuel pricing and taxation, congestion charging and the promotion of the use of public transport, walking and bicycle transport. Consideration of future transport requirements in city and industrial planning is also essential. These are some of the measures being introduced overseas in car-dominated cities, after the problems have arisen. China still has the opportunity to shape its transport system for the realities of a world in which petroleum will become increasingly scarce. Petroleum scientists have an important role to play in communicating the urgency of the oil shortage situation to decision-makers.

4. Conclusion

Oil and gas resources are the most important strategic materials to ensure the national economy, politics and military security. Since the foundation of the state, the oil industry of our country has made enormous achievements. The annual production of crude oil has risen to 1700 million tons in 2003 from 120,000 tons in the early days of our liberation, making important contributions to national economic and social development. However, with the ever-increasing growth of the national economy, the imbalance between supply and demand of energy especially oil and gas resources is becoming more and more severe. This has already become the main bottleneck restricting economic and social development.

The solution to this problem is: ① While keeping a steady production of the domestic crude oil and increasing the development of natural gas, we must make greater efforts to expand and utilize overseas oil and gas resources and to set up an economic and stable oil and gas supply channel and security system of petroleum. ② We must increase the expenses on science and technology and develop substitute energy. At the same time we should adopt a policy of paying equally great attention to oil and gas exploration and to oil and gas conservation in which priority is given to the latter, and to set energy saving as a long-term goal, which can be achieved through the efforts of the entire society. ③ We must also look to the advance of science and technology to greatly improve the efficiency of exploration, processing utilization and conservation of oil and gas. ④ we should take all the measures to decrease the dependence on oil and gas resources and make China becoming a modern

country with high efficiency and saving resources.

Reference

.Shen Pingping, Zhao Wenzhi, Dou Lirong and etc. (2004) Future of China petroleum resources and increase trend for proved reserves in the coming ten years, *Petroleum Journal*, vol.21:2-6.

.Jia Wenrui, Xu Qing and Wang Yanling. (2003) Development Stratagem for oil and gas industry under the goal of double the GDP of China in 2020, *Research and Approach*, vol. 25:18-24.

.Chen Yueming and Li Shuxia. (2002) World petroleum resources and the condition and trend on exploitation technology, *Petroleum geology and rate of recovery*, vol.9:2-4.

(4).Zhou Zongying. (2003) Analysis on China's oil production and development potential, *China mining industry*, vol.12:4-7.

(5).Zhou Fengqi. (2001) Expectation on China's oil supply and demand and suggestion, *World petroleum economy*, vol.8:5-8.

(6).Zhou Fengqi. (1999) Challenge faced by China's energy industry in 21st century, *China energy*, vol.5:3-6.

(7).Guo Baoshen and Li Haiying. (1997) Prediction on China's oil production in the early 21st century. *Management on geological science and technology*, vol.5:51-53.

(8).Zhou Zongying, Zhang Kang and Zhou Qingfan. (2001) Character and trend analysis of China's gas reserves and production in recent years, *Gas and earth science*, vol.12:1-9.

(9).He Dongping, Zhang Shihong and Qi Yutang. (2004) Development and expectation on China's biogenic diesel-fuel, *Grain processing and foodstuff technology*, vol.6:10-12.

.Mu Shuling. (2004) The development stratagem of SINOPEC on the basement of recent development trend, *Petroleum and petrochemical today*, vol.12:7-9.

(11).Zhang Kang. (2001) The development frame of China's gas industry in the early 21st century. *World petroleum economy*, vol.8:27-31.

(12).Zhang Rong. (2004) Resources potential analysis on China's available importation oil in the future, *Petroleum and petrochemical today*, vol.12:26-29.

(13).Zhao Fuxing. (1996) Condition of China's oil and gas resources and its prospect, *World petroleum economy*, vol.4:1-6.

(14).Bruce Robinson.(2004)Oil Depletion:An Interview. Presentaion in the symposium in China University of Petroleum.